VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi, Karnataka - 590 018

SYNOPSIS

Report on

Design and Development of "ARECANUT HARVESTING AND SPRAYING MACHINE"

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor Of Engineering

in

Mechanical Engineering

by

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CHAPTER 1

INTRODUCTION

The main purpose of our Project is to help small scale farmers who having land area less than 5 acres, by designing areca nut tree climbing and harvesting machine, we can harvest more nuts according to the previous method, It's a fully manual device, without any external source, Our project work will focus on economy of harvesting operation. It is a time saver at low cost by considering different costly equipment in the market. As the requirement for areca nut is increasing day by day, therefore the target was to create the machine which is affordable to each and every farmer, which is cheaper, efficient and will reduce the total harvesting cost. To achieve this aim, it is decided to follow the following steps

- To understand farmer's problem which they are facing about harvesting, for this it is decided to interview the farmers. So as decided we surveyed the farmers who are having land less than 5 acres.
- As the design is based on the requirement and demand for compact efficient and affordable harvester. This demand could be seen only with interaction with farmers of having land less than 5 acres. The most of the farmers were from India. We also found that there is essential to have small scale harvester with each formers for reducing their harvesting cost.

We have gone through many other projects done before and came up with a design that is cheaper and easy to operate and maintain.

CHAPTER 2

LITERATURE SURVEY

Mani A, Jothilingam A

They discussed about the development and fabrication of a tree climber and harvester. It consists of two mechanisms. One for climbing and another for harvesting. They designed anoctagon shaped chassis where wheels at specific intervals were provided. The proposed design by Mani and Jothilingam had the location of center of mass of the device outside the tree and it fused both spiral and straight climbs. An arm was provided in order to fulfill the harvesting requirement. The bunch of nuts is located by a camera which is fixated to the arm. The cutting is done by a saw after a clear view of the nuts is obtained. The entire mechanism was controlled by remote control. They discussed about the hardware setup and controlling units were designed.

Rajesh Kannan, Megalingam, R Venumadhav

Analyzed various models of climbing and harvesting devices. Safety, reliability, ease of use, cleaning the tree tops, spraying pesticides were given prior importance. They designed a system that can be controlled by anyone. The designed prototype responds to human gestures with negligible gap in the response time. A prototype of the arm was designed and tested against human gestures and found successful. Their machine was designed to consume less power, so longer working hours doesn’t affect the power consumption.

P. Mohankumar, D. Anantha Krishnan and K. Kathirvel

They discussed about the ergonomical parameters and ergo refinements of their design model. They designed two models and selected one through trial and error testing on basis of lower physiological cost, safety and discomfort. The inclination of the upper frame of climbing device is increased with respect to the horizontal, while moving towards the top. This resulted in unstableness and insecurity of the labor.

Rahul V, Sebin Babu, Sameer Moideen CP

They used three linear electrical actuators – two for gripping and one for vertical up and down motion in their climbing device. They analyzed the model and found the design to be safe. Their climbing mechanism is very similar to a man climbing a tree. They tested their prototype under real life conditions and suitable changes were incorporated. In their paper, "Semi Automated Tree Climber", they discussed about the possibilities of modifying this device.

Justin Gostanian, Erick Read

Discussed about the design, construction, and testing of a robot to climb trees to detect Asian Longhorn Beetle infestation. The primary goal was to design and build a robot that could successfully climb a tree. After researching existing climbing robot designs, a robot prototype was built using concepts from the existing designs. The prototype was then tested to determine the effectiveness of the design. The prototype proved to be partially successful, being capable of gripping a tree and staying on, but could not move. Though not entirely successful, the project identified many important aspects in a tree climbing robot's design.

CHAPTER 3

OBJECTIVES

- In an attempt to assist the climbers, to avoid wastage an arecanut tree climbing robot has been designed to meets the following objectives.
- To design and develop the PORTABLE, EFFICIENT areca nut harvesting machine.
- To make the harvesting work more EASIER
- To make the work less RISKY and AVOID ACCIDENTS
- Using required attachments to AVOID DAMAGE OF NUTS
- To reduce the cost of the machinery
- To use easily available parts to make maintenance cheap and easy

CHAPTER 4

DESIGN AND METHODOLOGY

The arecanut tree climbing and spraying machine works on basic principle of friction that is the relative lateral motion of two solid surfaces in contact. The machine developed consists of a base frame with 4 nylon wheels driven by 4 high torque geared motor. The machine is having a Rectangular shape, hinges are provided on each links for the movement of links with the variation in size of the tree. A spring is used to provide sufficient grip to the wheel on the tree according to the change in the size of the tree. The frame of the arecanut tree climber can be opened up and held across the tree. The setup is connected across the tree. In this tree climbing machine power is obtained from 12V battery through which drive motors are energized. A relay system is used for the movement of the wheels. When the relay is switched on, the motor rotates the shaft which in turn rotates the wheels in clockwise direction. Due to the friction between drive wheel and the bark of the tree machine rises up along the length of the tree. The contact friction between the wheel and tree is maintained with the help of spring and grippers on the wheels. The only component which is in contact with the tree is the wheels which are made up of nylon. Hence it does not cause any damage to the bark of the tree. When the setup reaches on top of the tree the motor is made to stop by the key press in the relay remote-control unit. The tension of the spring helps to retain the machine at the required height. Then the wiper pump motor is switched ON by other key press in the relay. Then the pesticide is being sprayed. This water pump is provided with 5V supply voltage. After which the pump is stopped, the whole setup is being brought back by changing the polarity of the switch so that the drive motor rotates in opposite direction there by making the wheels rotate in opposite direction. After reaching the ground the ground the setup is removed from the tree and attached to the next tree for spraying.

4.1 CALCULATIONS

Force Calculation

Assuming weight of the machine,

W = 5.5 kg W = 5.5×9.81 W = 53.955 N.

Assuming coefficient of friction between tree and rubber grip,

Âµ = 0.3

Actual Force to be lifted,

F=W/Âµ F=53.955/0.3 F = 179.85 N

Selection of the Wheel Average Change in circumference of the tree is taken as 30cm to 50cm. It was observed that the maximum circumference of an arecanut tree is 50 cm and minimum circumference at the top is 30 cm. 10 cm wheel is used in this machine for the torque restriction of the motor.

Length of Link

Length of each link is taken as 9

Torque Calculation Calculating motor torque,

Torque [Nm] = Mass [Kg] Ã— g Ã— Radius [m] Torque = 8.5Ã—9.81Ã—0.05

= 4.169 Nm.

COMPONENTS SPECIFICATION

4.1.1 MOTOR

12 volt DC geared motor.

Speed – 30 rpm max.

Torque – 25kgcm.

Weight – 250 grams.

4.1.2 WHEELS

Radius – 5cm.

Width – 5cm.

4.1.3 FRAME

MATERIAL – Aluminium alloy

SHAPE – rectangular

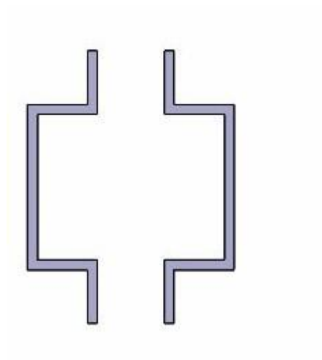
LENGTH – adjustable

WIDTH - 30 cm

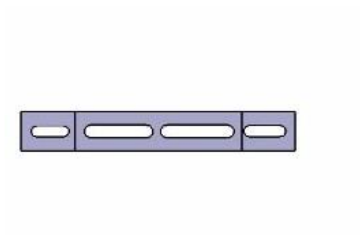
4.1.4 8 CHANNEL RELAY BOARD

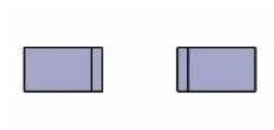
4.4 CAD MODLING

FRAME

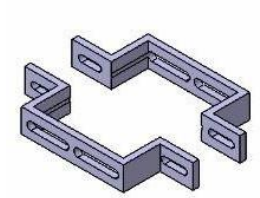


TOP VIEW



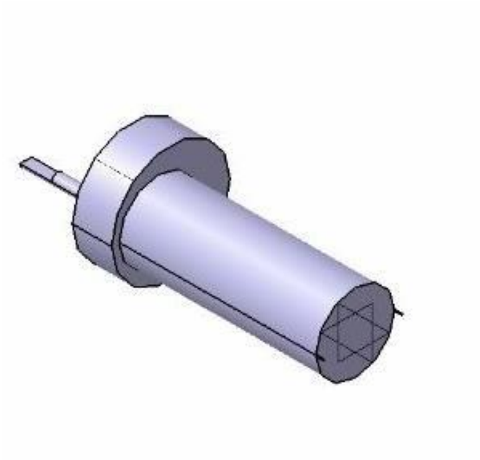


SIDE VIEW



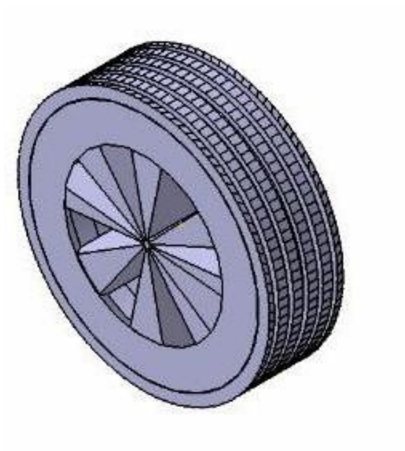
ISOMETRIC VIEW

MOTOR



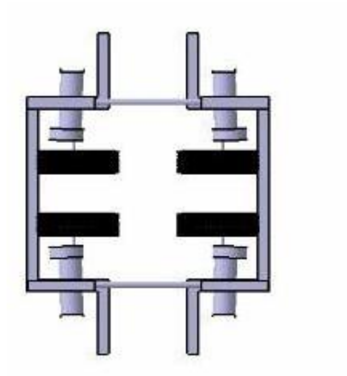
ISOMETRIC VIEW

WHEEL

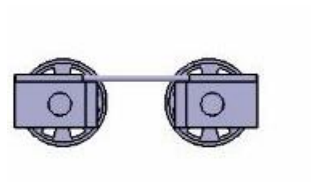


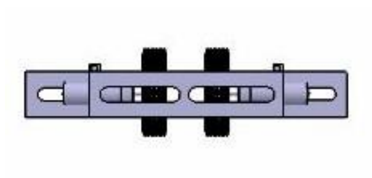
ISOMETRIC VIEW

FINAL ASSEMBLY

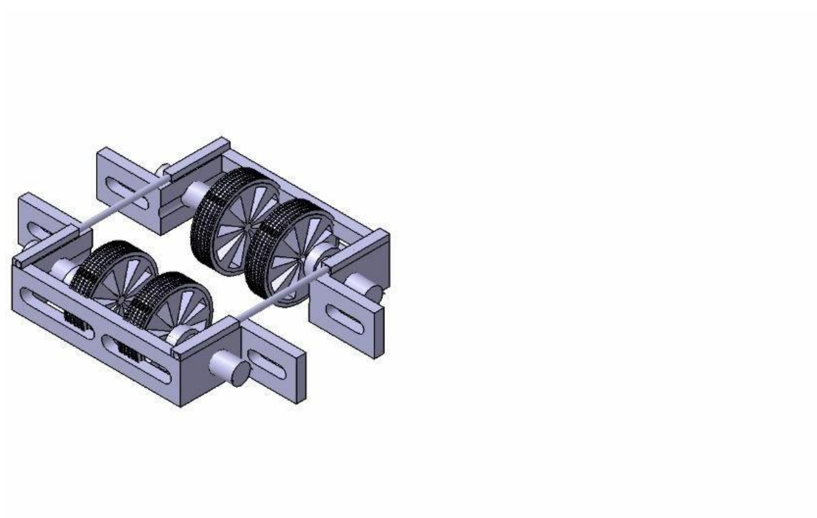


TOP VIEW



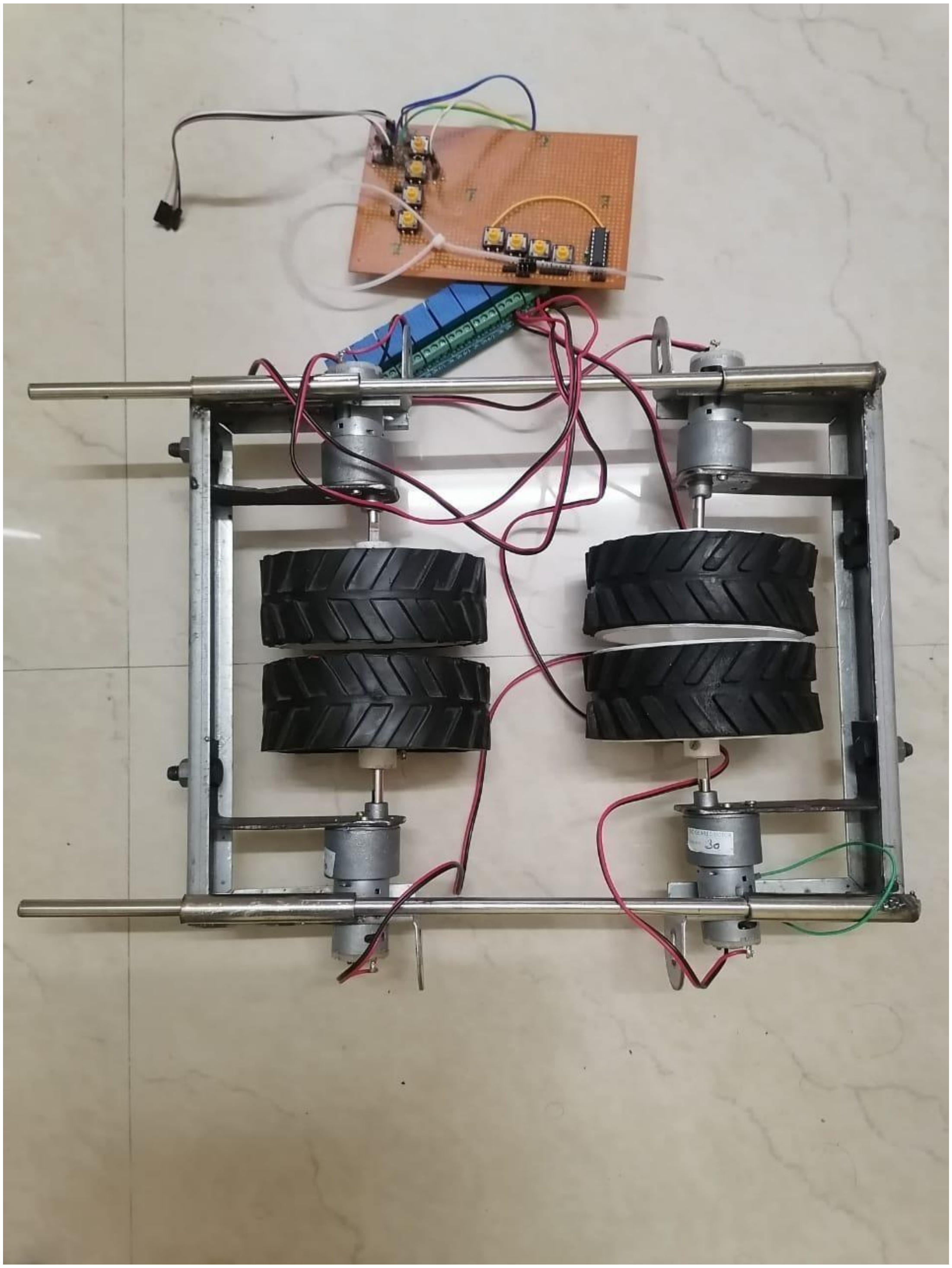


SIDE VIEW



ISOMETRIC VIEW

5.5 FINAL OUTCOMES



CHAPTER 6

CONCLUSIONS

The design and analysis of Areca nut tree climber with pesticide sprayer will be implemented in a comparatively low cost. This will reduce the rate of accident in future.

This is more effective technology for climbing Areca nut trees. The aim of our device is achieved. The design of the product is fabricated as per the calculation and the exact efficiency is achieved by the finished product.

The loads of the parts as well as the crop nuts were held firmly by the product. The product satisfies the small scaled farmers purpose by providing high profit to them in the harvest process, thus ultimately provides right time to harvest the crop nuts.

The yield capacity is perfect so that the harvesting process takes only one time for a single tree as the product can harvest the crop nuts from the palm tree that is to be harvested.

The advantage of the areca nut tree climbing is very smoothly without damaging the tree. An unskilled labour can operate the machine safely and efficiently. Climbing the single tree, an average of 15 to 20 trees can be harvested/sprayed. This project concludes that the areca-nut tree climber is a safe, reliable, efficient and which reduces the risk in climbing the areca -nut tree to a good extent.

Innovations in the project

- The design of the frame is completely new, uses two components, very easy to install and maintain.
- Other designs used the compression force of the spring to make grip, but we have used tensile force of the spring.
- The overall cost of the project is around 25000 rupees, which will include a cutting tool and spraying tool, as compared to other machines available in the market which cost around 50000 rupees.

CHAPTER 7

SCOPE FOR FUTURE

Arecanut tree climbing and harvesting machines have the potential to play a significant role in the future of agricultural automation. Here are some factors that suggest a scope for these machines:

Labor shortage: Many agricultural regions face a shortage of skilled labor, including experienced arecanut tree climbers. As rural populations shift to urban areas, the availability of manual labor for climbing and harvesting trees becomes increasingly scarce. Arecanut tree climbing machines can help bridge this gap by automating the process and reducing the dependence on human labor.

Efficiency and productivity: Arecanut tree climbing machines can significantly enhance efficiency and productivity in arecanut farming. These machines can climb trees faster and with greater accuracy compared to manual climbing, resulting in increased harvesting speed and higher yields. With improved technology, these machines can be optimized to minimize tree damage and maximize nut collection.

Safety and ergonomic benefits: Climbing arecanut trees can be a hazardous task, posing risks to human climbers. The use of climbing machines can minimize the chances of accidents, injuries, and occupational health issues associated with manual climbing. Additionally, these machines can be designed with ergonomic features to reduce physical strain and fatigue on workers.

Precision harvesting: Arecanut tree climbing machines can be equipped with sensors and cameras to detect and harvest ripe nuts accurately. This precision harvesting ensures that only mature nuts are harvested, improving the overall quality of the yield. It also reduces wastage by avoiding premature or overripe nut collection.

Scalability and cost-effectiveness: As agricultural operations scale up, the demand for efficient and cost-effective solutions increases. Arecanut tree climbing machines have the potential to be scalable and adaptable to various farm sizes. By automating the climbing and harvesting process, farmers can reduce labor costs over time and achieve greater economies of scale.

Technological advancements: Advancements in robotics, artificial intelligence, and sensor technology contribute to the development of more sophisticated climbing and harvesting machines. These innovations enable better tree-climbing capabilities, enhanced sensing and detection, improved navigation, and increased automation, further driving the scope for such machines in the future.

While arecanut tree climbing and harvesting machines are not yet widely adopted, the growing challenges faced by the agriculture sector, coupled with advancements in technology, suggest a promising future for their use. However, factors such as cost, machine reliability, adaptability to different tree sizes and varieties, and acceptance by farmers will influence their widespread adoption and market penetration.

REFERENCES

1. Eldhouse paul et al, "Semi-Automatic areca-nut tree climbing and harvesting robot," July 2017.
2. A Vasanthi et al, "Robotized areca-nut tree climber and pesticides sprayer," 2017.
3. Mohit Rane et al, "Design of semi-automated areca-nut tree climbing plucker", May 2019 .
4. R. Gokulraju et al, "Areca-nut tree climber," 2017.
5. S. M. Arun Kumar et al, "Removing the bunch of areca-nut from the plant and spraying of pesticides by using remote operated device," August, 2020.
6. T. K. Fasil et al. "Remote controlled arecanut plucking machine," April 2018.
7. J S. Basavaraja et al., "Design and development of areca tree climber," November 2010.
8. A Prasad et al., "wireless palm tree harvester," March 2016.
9. Rahul V, et al. 2015 Semi automated coconut tree climber IJRET: International Journal of Research in Engineering and Technology 4.
10. DileepEdacheri, PrakashUnakal –Design of a Coconut Tree Climbing Device - in International Journal of Innovative Research in Science, Engineering and Technology Manufacturing Technology.
11. Ahmed Salih Mahdi. Al-Zuhairi 2013 Semi automatic tree climber –in International Journal ofAgriculture & Research (IJAR) –Volume 4Issue 7.
12. Nallusamy.V,N.Shrivathsan, Vinoop.U, Satish.M, Yashwanth.N.G 2015 Tree Climbing Robot –JEST-M, Vol 4, Issue 4.
13. Veerabhadhra - Development of Automated Coconut Harvester Prototype - International journal of innovative research in science, engineering and technology.
14. N S Kannur - Design And Fabrication Of Coconut Tree Climb ing Equipment - International journal of innovative research in science ,engineering and technology.
15. Balasubramanian M; Panwar J S. 1986 Mechanical properties of Areca Nut (Areca catechu linn) as related to de-husking. Journal of Agricultural Engineering (ISAE),23(1), 82–88.